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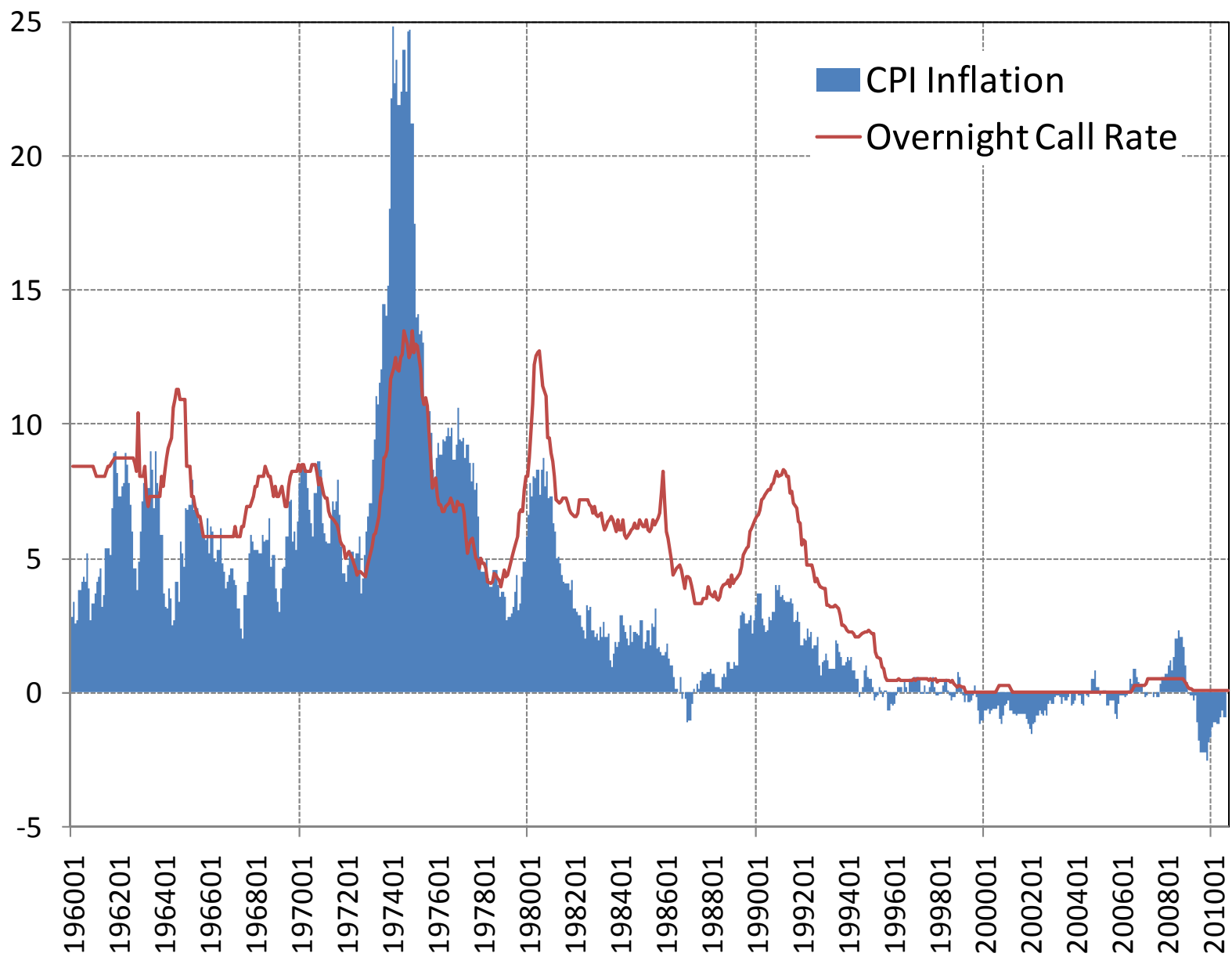
Understanding Inflation Dynamics of the Japanese Economy

Closely Competing Firms and Price Adjustment: Evidence from an Online Marketplace

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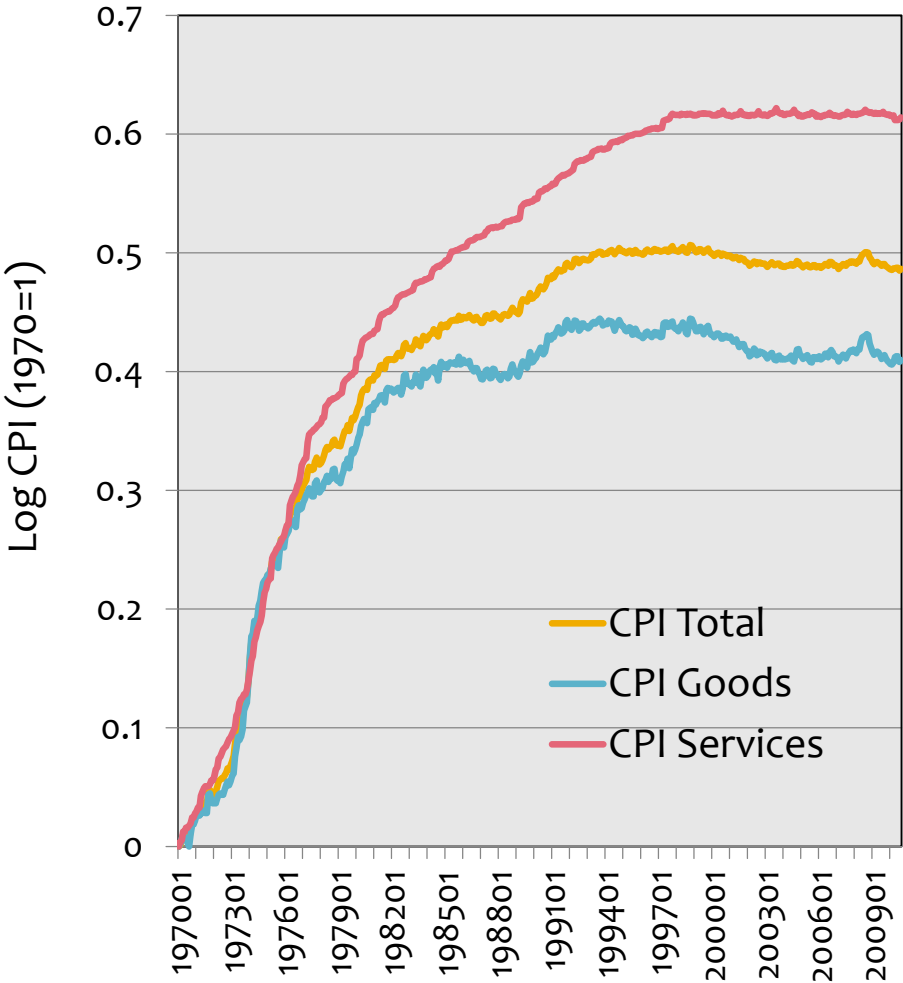
In collaboration with T. Mizuno and M. Nirei

March 3, 2011

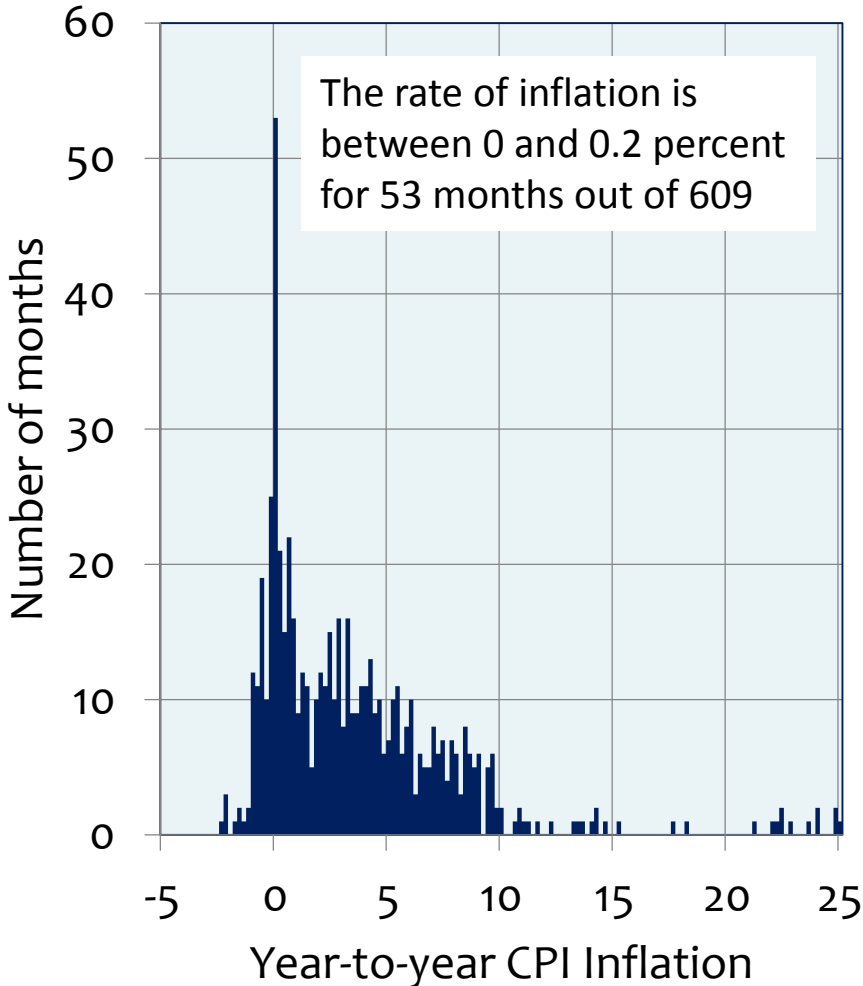


Japan's deflation is mild, but persistent

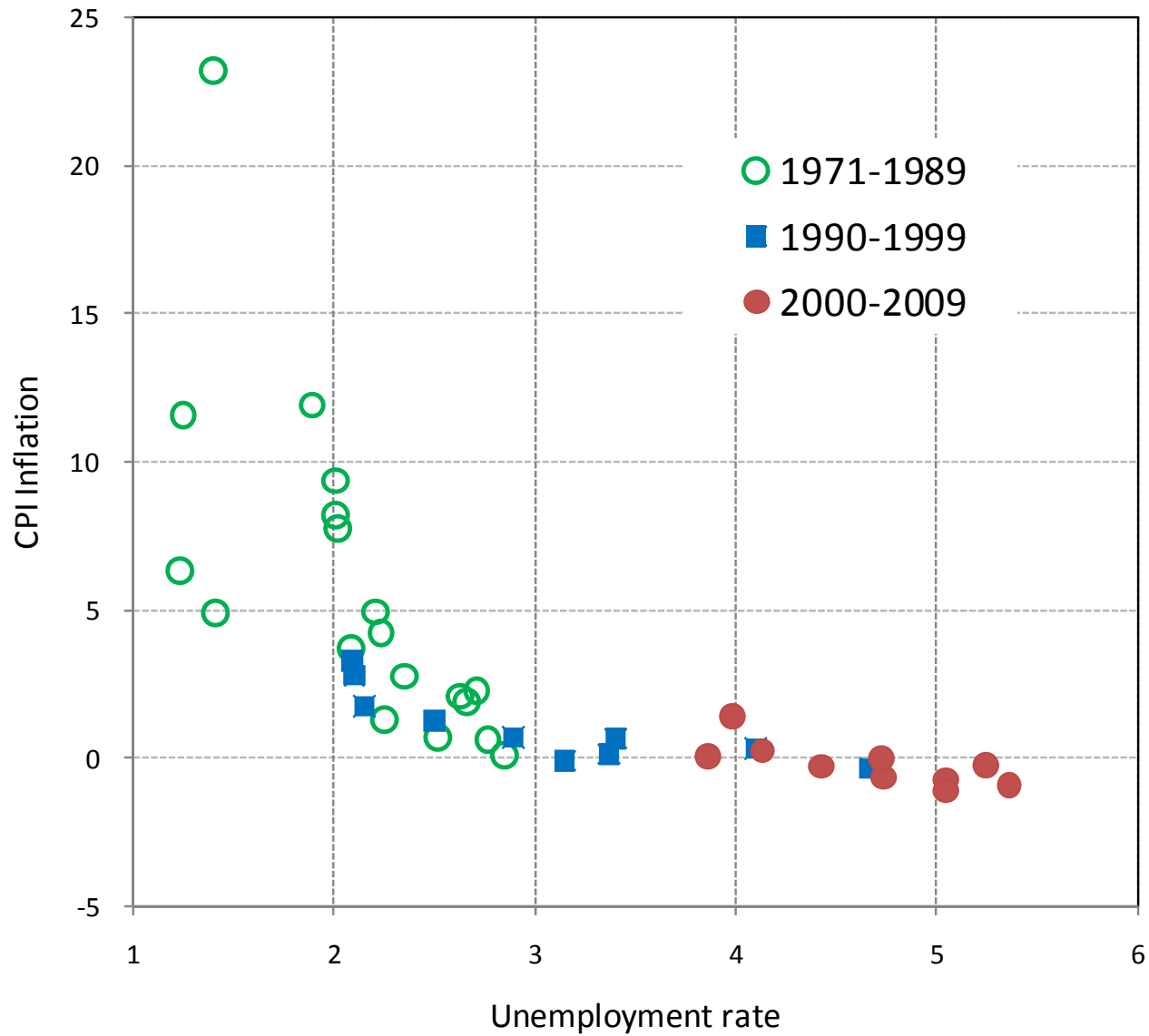
Consumer Price Index



Histogram of CPI Inflation Jan 1960 to Sep 2010



Japan's Phillips curve in 1971-2009



Price stickiness at micro and macro levels

- Since Bilal and Klenow (2004), there has been extensive studies on price stickiness using micro price data. These studies focus on the frequency of price adjustment events, or equivalently on the length of a price spell.

Estimates of the Frequency of Price Adjustments

Probability of adjustments per month, percent

	Total	Processed foods	Manufactured products	Service
Japan	25	31	23	4
US	25	27	22	15
Germany	14	9	5	4
France	21	20	18	7
Italy	10	9	6	5

Price stickiness at micro and macro levels

- Since Bils and Klenow (2004), there has been extensive studies on price stickiness using micro price data. These studies focus on the frequency of price adjustment events, or equivalently on the length of a price spell.
- However, the estimated micro price stickiness is too low to account for the stickiness at the macro level.

$$\text{“Contract multiplier”} = \frac{\text{Duration of real effect of monetary policy}}{\text{Length of a price spell}} = \frac{24 \text{ months}}{4 \text{ months}} = 6$$

Multiple rounds of price adjustment

Period	-1	0	1	2	3	4	5	6	7
MC	100	80	80	80	80	80	80	80	80
Retailer A	100	100	90	90	90	80	80	80	80
Retailer B	100	100	100	90	90	90	80	80	80
Retailer C	100	100	100	100	90	90	90	80	80

It takes **6 periods** for new information about marginal costs to be fully reflected in the prices quoted by A, B, and C. However, if one calculates the average length of price spells, one obtains **3 periods!**

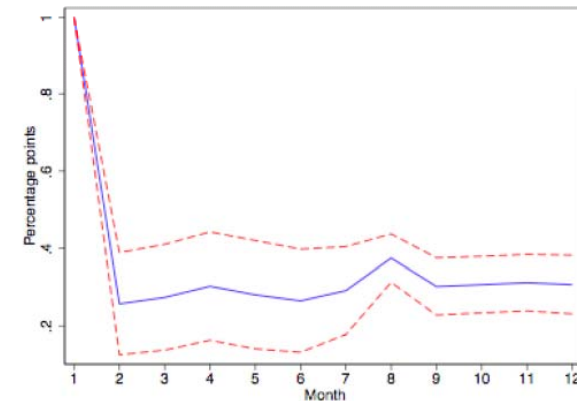
Our empirical strategy is to measure **the length of clustering** (or temporal agglomeration), and compare it with the length of each price spell.


Evidence on the presence of multiple rounds of price adjustment

- Bilts, Klenow, and Malin, “Reset prices and monetary policy shocks,” February 2009

- The presence of strategic complementarities implies a high persistence of inflation.
- However, the US CPI source data shows the lack of persistence in inflation.

Empirical Impulse Response of Reset Prices, All Goods



- 
1. CPI statistics is compiled by collecting a price from a particular retailer for a particular product. Thus CPI source data does not contain multiple price quotes collected from competing retailers. We go to an online market to collect prices from competing retailers.
 2. Bilts et al (2009) focus on persistence in the intensive margin. We will investigate persistence both in the intensive and the extensive margins .

Caballero-Engel's generalized Ss model with strategic complementarities

- The opportunity of price review arrives according to a Poisson process with a probability θ

- Target price:

$$P_{it}^* = (1 - \alpha)m_t + \alpha[\omega P_{t-1}^A + (1 - \omega)P_{t-1}^{NA}]$$

- Adjustment hazard function:

$$\Lambda = \Lambda(x_{it}) \quad \text{where } x_{it} \equiv P_{it-1} - P_{it}^* \quad \begin{array}{l} \Lambda'(x) > 0 \text{ for } x > 0 \\ \Lambda'(x) < 0 \text{ for } x < 0 \end{array}$$

- Caballero-Engel's measure of price flexibility:

$$\lim_{\Delta m_t \rightarrow 0} \frac{\Delta P_t}{\Delta m_t} = (1 - \alpha)(1 - \theta) \left[\int \Lambda(x)h(x)dx + \int x\Lambda'(x)h(x)dx \right]$$

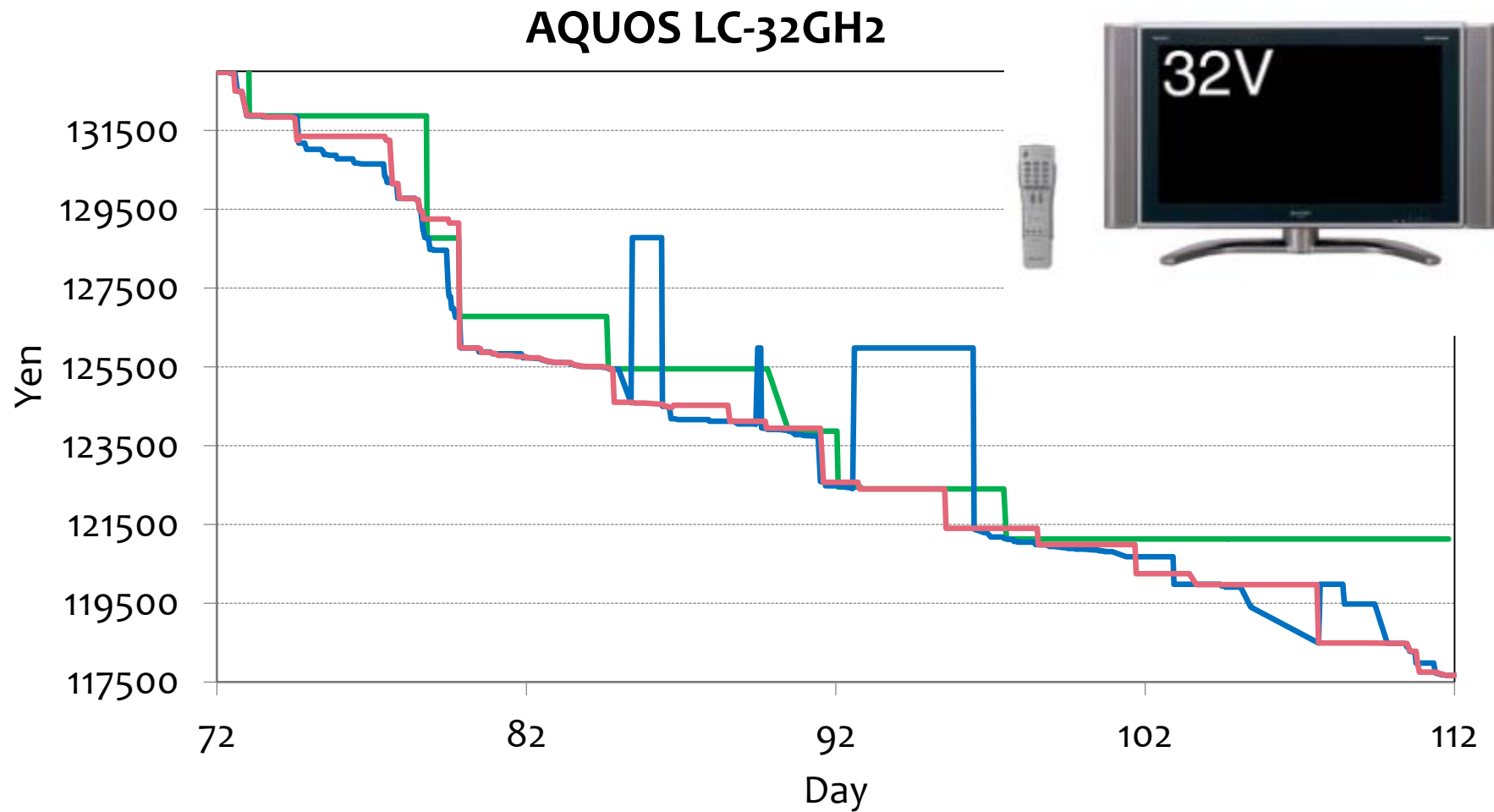
Data

Kakaku.com dataset



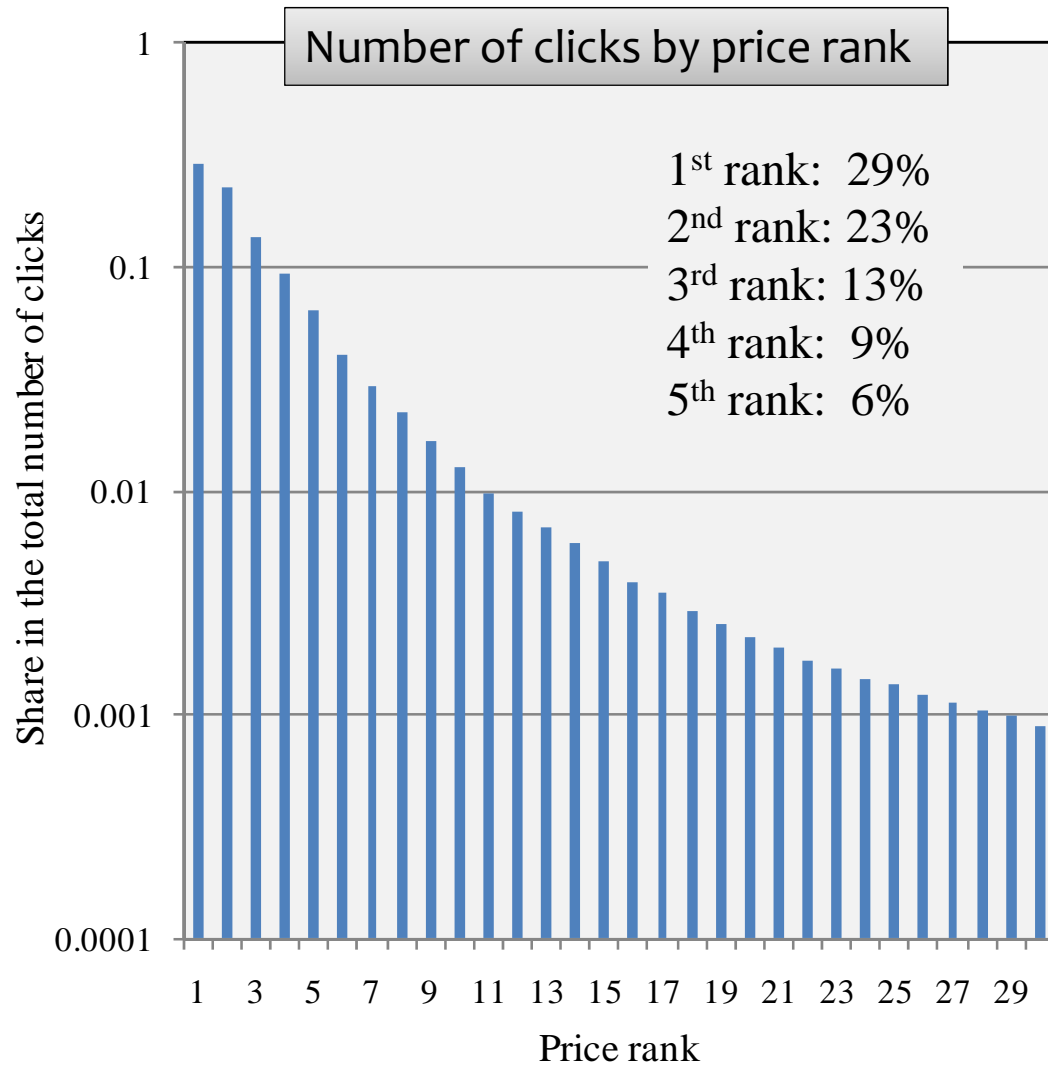
- Compiled jointly by Kakaku.com, Inc. and Research Center for Price Dynamics
 - 300,000 products; 1300 retailers; 12 million users per month
- Kakaku.com, Inc. and each retailer enter a contract (on the payment of fees depending on transferred customers, etc.) before any prices are listed.
 - Based on information sent to them by Kakaku.com, Inc., retailers check three or four times a day, or more frequently, the prices offered by other retailers, the overall rank of their own price, whether the number of customers transferred to their own site is large or small.
- The dataset consists of:
 - the records, with a time stamp up to the second, of all prices offered by each retailer (about 100 million records per year)
 - the records, with a time stamp up to the second, of all customer clicks on the “Go to retailer” button for all products (about 100 million records per year)
- November 1st, 2006 to October 31st, 2008.

Prices of a particular model of LCD TV offered by three competing retailers



How does the data look?

Is this a perfectly competitive market with homogeneous products?



Heterogeneity across different retailers in terms of various services associated with delivery and payment



The first rank retailer obtains many clicks, but not necessarily all clicks.

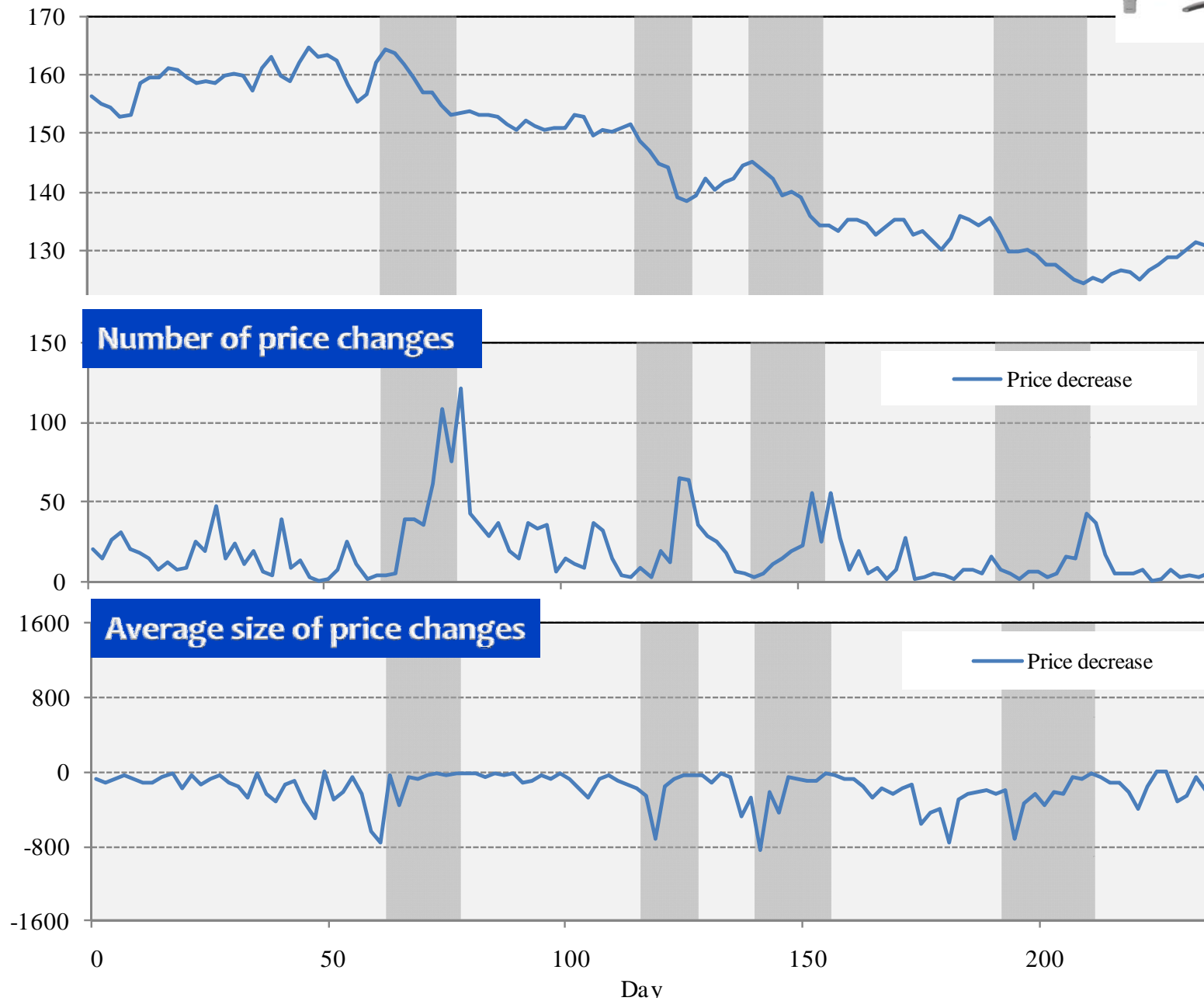
Imperfectly competitive market with differentiated varieties of a product

Empirical results

Fluctuations in the average price of AQUOS LC32GH-2



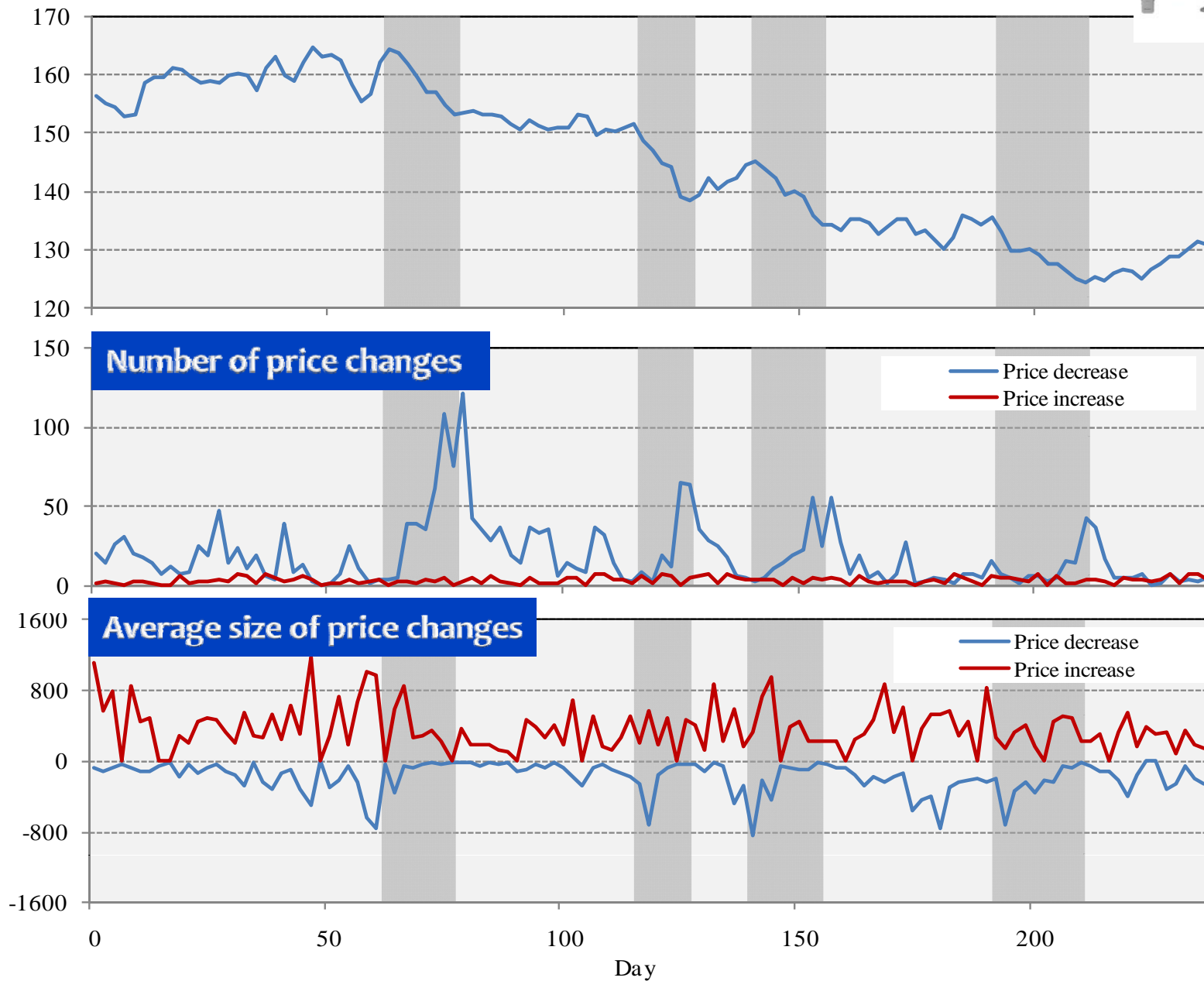
thousand yen



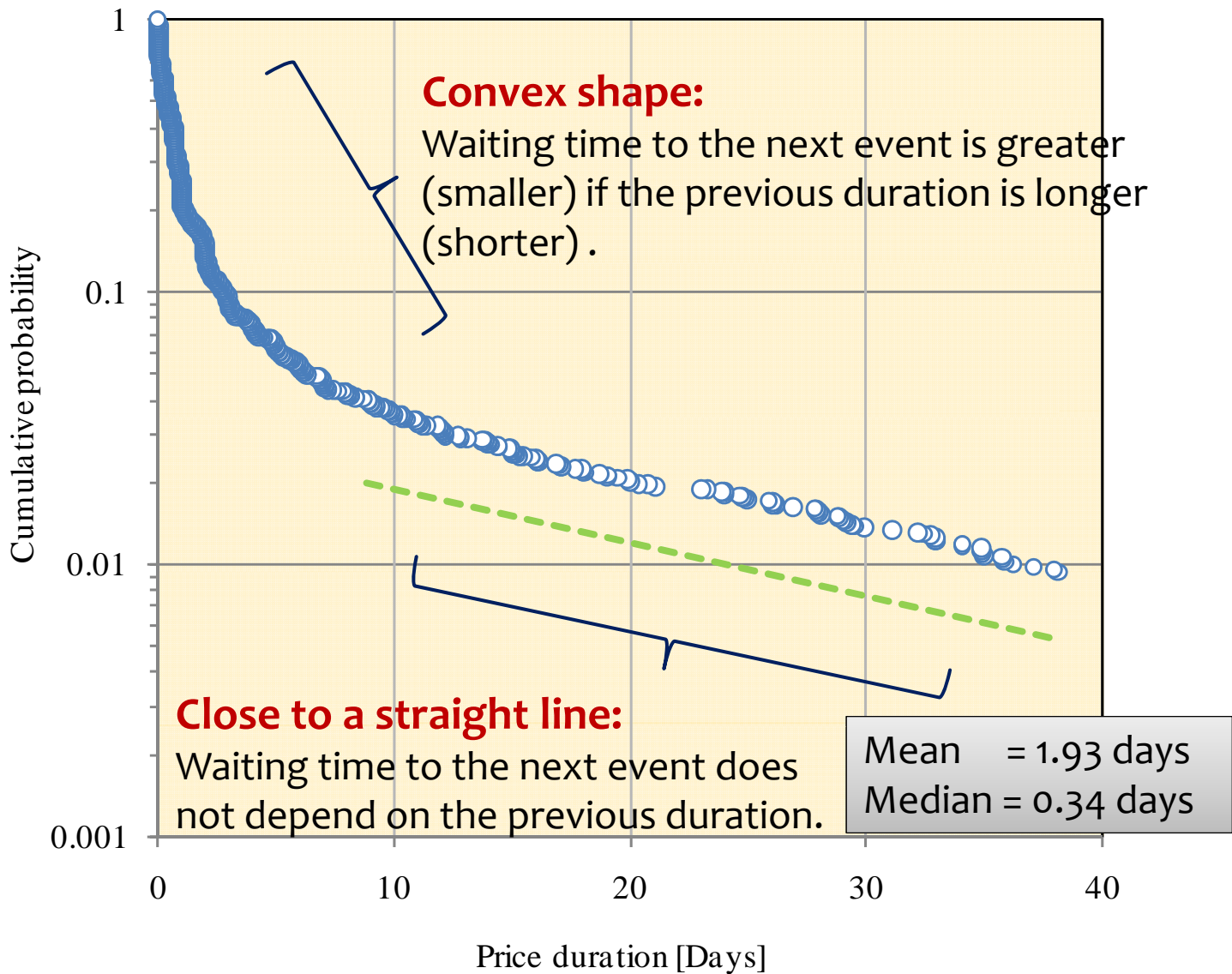
Fluctuations in the average price of AQUOS LC32GH-2



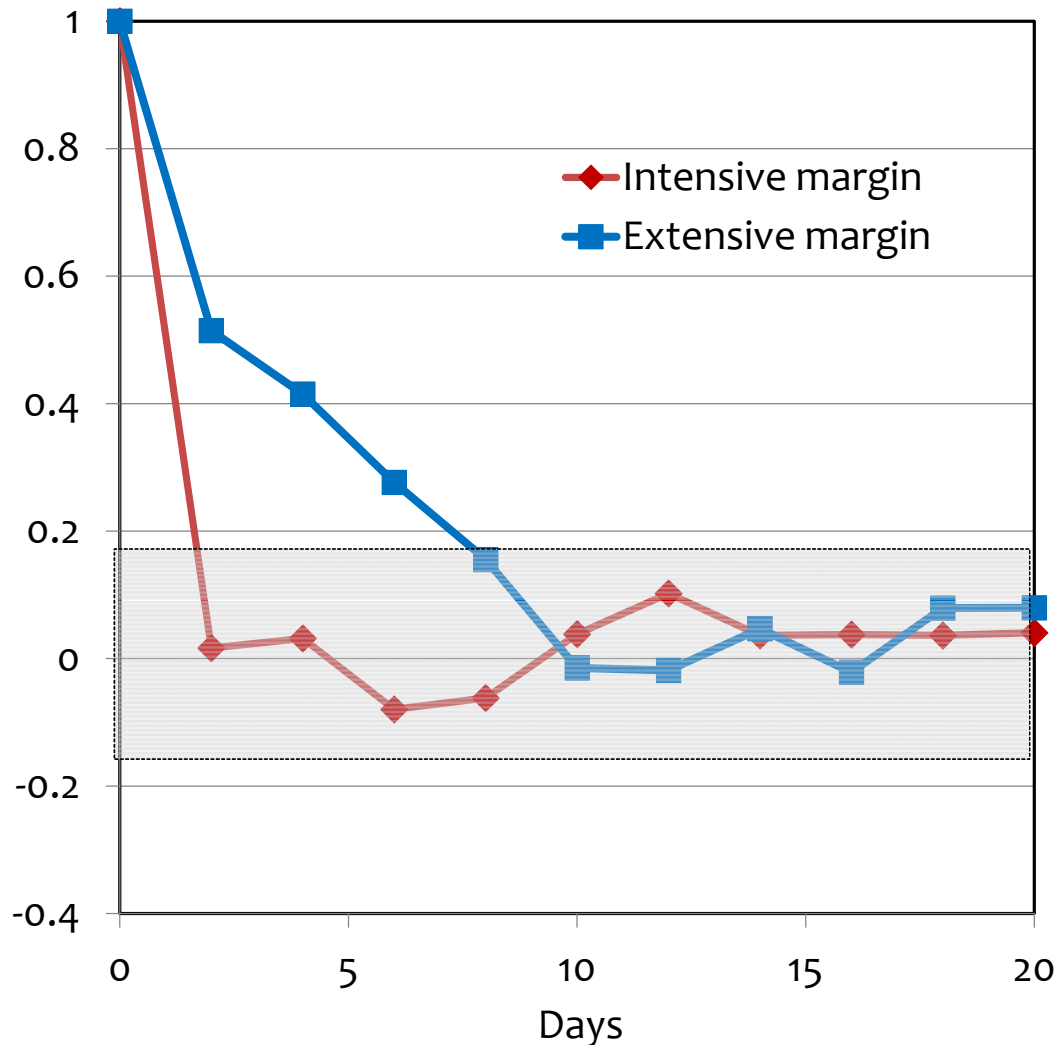
thousand yen



Cumulative Distribution Function of the Price Duration



Autocorrelation functions of the intensive and the extensive margins



$$T \equiv \max\{\tau_1, \tau_2, \dots, \tau_{128}\}$$

τ_i Waiting time until retailer i experiences its first Calvo event

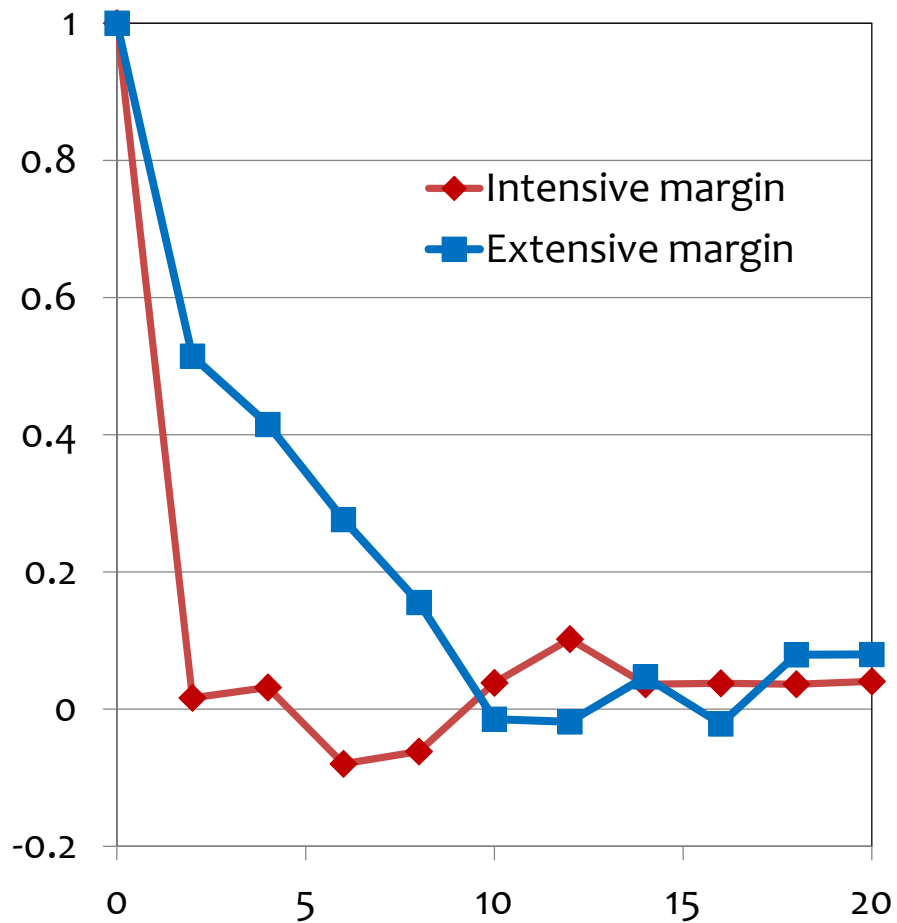
T Waiting time until all of the 128 retailers experience at least one Calvo event

➔ $E(T) = 1.89$ days

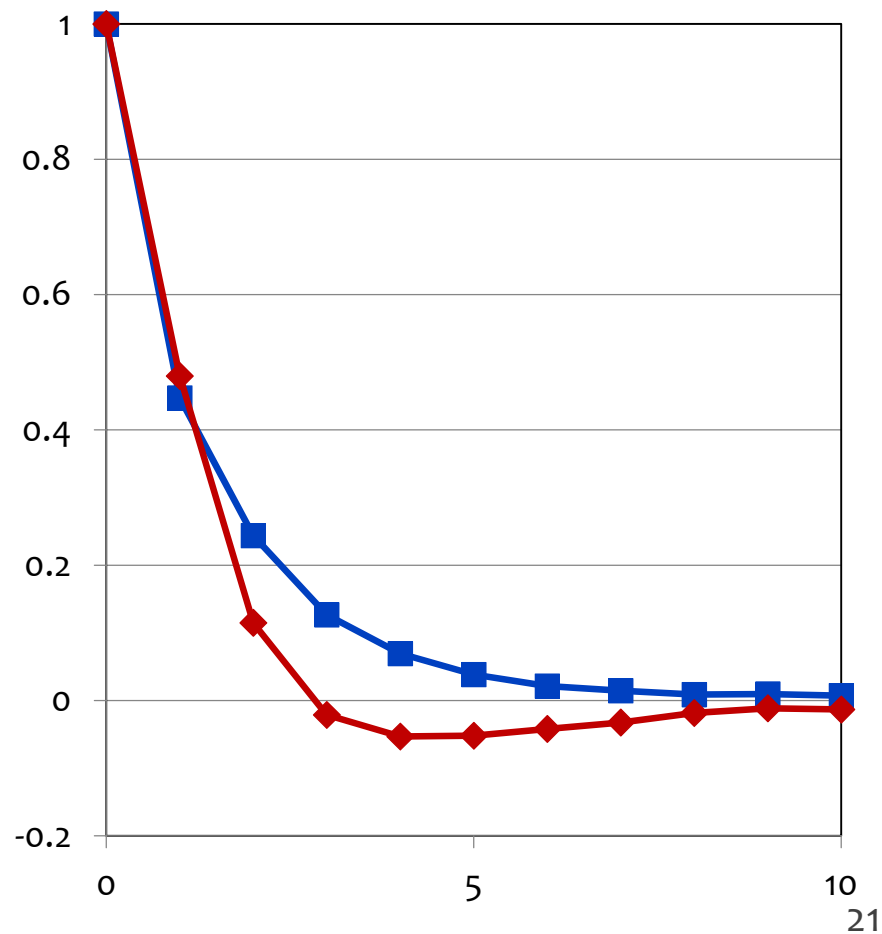
This implies that each of the 128 retailers conducts, on average, **5.3 rounds of price adjustment** before the entire process of price adjustment is completed.

Autocorrelation Functions of the Intensive and the Extensive Margin

Empirical



Simulated



Conclusion

- We fail to find any significant persistence in the intensive margin (the size of price changes), which is similar to the finding by Bils et al (2009). However, we find positive autocorrelation in the extensive margin (the frequency of price changes). There tends to be clustering where once a price adjustment occurs, such adjustments occur in succession.
- The estimate of the length of such clustering is about ten days, which is about five times as long as implied by the Bils-Klenow type estimate of the length of price spells. This implies that each retailer goes through, on average, **five rounds of price adjustment** before the entire process of adjustments is completed.
- These findings suggest that retailers imitate each other when deciding to adjust (or not to adjust) their prices. Importantly, the extensive margin plays a more important role than the intensive margin in such strategic complementarities in price setting.

Kinked Demand Curve

Number of clicks vs. relative price

